7—*A Study of the Palaeozoic Genus* Hercynella, *with Description of Three Species from the Yeringian (Lower Devonian) of Victoria.*

By EDMUND D. GILL, B.A., B.D.

[Read 12th December, 1946]

Abstract

Hercynella is a primitive gasteropod which has previously been classified as a pulmonate. Evidence is put forward which suggests that it is a normal marine gasteropod and not a pulmonate. This evidence deals with its analogies with other fossil forms, its ecology, and the palaeontological history of pulmonates. Three species, including two new ones, are described.

Taxonomy

The classification of the genus *Hercynella* is most difficult, and can never be fully objective, because of the lack of structures in the exoskeleton to provide clues of what the animal was like. Apparent genetic relationships as indicated by analogy, and ecological considerations, are the only guides in its classification.

History of the Genus

Emanuel Kayser erected the genus in 1878; its species range from Middle Silurian to Middle Devonian. Barrande studied shells of this type, but believing them to be very like the extant genus *Pilidium* Forbes, used the generic name *Pilidion* in his manuscript. Kayser was of the opinion that Barrande was mistaken in referring his asymmetric shells to the above genus of extant symmetric gasteropods, and proposed the name *Hercynella*. Perner pointed out that *Pilidion* latinized becomes *Pilidium* and so should be rejected as a junior homonym; Knight has shown that in any case the name was already occupied.

O'Connell (1914, p. 94) claimed that "since the species *bohemica* was the type of Barrande's genus, it remains the type of *Hercynella*." This is apparently a reference to the description of *H. bohemica* as genotype in Perner (1911, p. 270). However, Cossmann had already defined *H. beyrichi* as genotype (1878, p. 142). Knight (1941, p. 146) has brought together information on the genotype of *Hercynella* as follows:

"Genotype, by subsequent designation of Cossmann, 1895 (p. 142) *Hercynella beyrichi* Kayser, 1878.

Objective Synonyms:

1. *Pilidium* Kayser, 1878 (p. 101), a homonym of *Pilidium* Müller 1846, Forbes 1849, and Middendorf, 1851. Genotype, by objective synonymy, *Hercynella beyrichi* Kayser, 1878.
2. *Pilidion* Perner, 1911 (p. 270), a homonym of *Pilidion* Wagler, 1830. Genotype, by objective synonymy, *Hercynella beyrichi* Kayser, 1878."

Nature of Exoskeleton

Most living gasteropods have an exoskeleton which consists of a horny periostracum, under which are two layers of calcium carbonate (outer layer calcite; inner one aragonite). The periostracum is seldom preserved on fossils. Many *Hercynella* shells are exceedingly thin, e.g., *H. killarensis* (0.25 to 0.55 mm. thick), and if they were composed of calcium carbonate alone, they would have been practically useless as organs of support or protection. To have strength at all, it must have possessed, one imagines, a strong periostracum of some kind. The amount of calcium carbonate apparently varied from species to species, as some of the Bohemian forms, for example, had quite thick shells.

Surface features of the exoskeleton (generally called "ornament," a term which does not express the scientific conception of these structures) consist of (a) radial lines or folds, and/or (b) concentric lines or folds. The concentric structures may be regarded as an hypertrophy of growth line structures. In most cases the characteristic fold of the genus may be interpreted as an hypertrophy of a radial plica, but in some cases it is curved without relation to the ornament. Knight (1941, p. 147), says that the fold may be on either the left or the right side, an interesting point from the point of view of genetics.

The tendencies towards radial and concentric ornament are developed to varying degrees in the species described in this paper. *H. victoriae* has a radial ornament of very narrow folds or plicae, about one millimetre wide at the margin of mature shells. They are plicae and not costae, because they involve the whole thickness of the shell, appearing on the steinkern as well as in the external mould.

H. killarensis has concentric undulations superimposed on which are radial ribs and concentric lirae.

H. petasoida has narrow concentric undulations and growth lines with very faint and fine radial lirae.

Orientation

There is no way of determining for certain which is the anterior and which the posterior end of the shell, in *Hercynella*, because of the lack of muscle scars, etc. Analogy is the only aid. The patelliform and coniform shells described in Knight's (1941) monograph on "Paleozoic Gasteropod Genotypes" were listed, and it was found that the orientation of only seven of some 21 forms was known for certain. It was noted that in all cases except *Halophiala* (whose apex is sub-central), there is a displacement of the apex towards one end or the other, and any inclination of the apex or commencement of enrolment is in that same direction. In the seven genera whose orientation is known, the apex of five is displaced anteriorly, and of two posteriorly. Genera of similar form in Davies' (1935) "Tertiary Faunas" were then listed and seven were noted to have a displacement of the apex (*Helcion* and *Acmaea* were treated as the same genus for the present purpose, as their shells cannot be distinguished). In these it was noted that the apex is displaced posteriorly in five genera, and anteriorly in two—the opposite from the palaeozoic genera! A

special study would be necessary to determine to what extent these figures are significant, but the following points are worth making:

(a) The number of palaeozoic patelloid genera is much greater, which is to be expected in view of the fact that the cone is the original fundamental shape of the gasteropod exoskeleton. Davies suggests (1935, p. 209), that all the extant patelliform shells have been secondarily developed from more usual forms.

(b) That the displacement of the apex is the reversal in most genera, in the Tertiary, from that which occurs in most palaeozoic genera is interesting in view of gasteropod torsion, but the point needs further investigation anatomically and ontogenetically.

It would appear that as the majority of palaeozoic patelloid genera have their apices displaced anteriorly, the end of *Hercynella* towards which the apex is displaced, should, for the sake of description, be regarded as the anterior end.

Ontogeny and Evolution

Typical gasteropods develop a shell in the advanced larval stage, which, no doubt, acts as a protective organ. It is essentially a cap or cone which enlarges as the animal grows, i.e., as the membrane secreting the shell enlarges, it produces a larger shell section. The original cap or protoconch widens as it grows and results in the cone shape. This fundamental cone shape is modified in every conceivable way; every stage is present between a slightly inclined apex and a fully enrolled shell. The enrolment may be in the same plane, giving a euomphaloid shell; or it may circle an imaginary axis to give anything from a low spire to a *Turritella* type. Sometimes the cone is coiled loosely and sometimes tightly. All manner of variations in so-called ornament are also to be found. These features were apparently all governed by genes, as they were inherited from generation to generation.

Now just as *Lingula* among the brachiopods has maintained the simple brachiopod exoskeleton (a dorsal plate and a ventral plate), throughout almost the whole of the palaeontological sequence, so there is a succession of gasteropods which have maintained the simple conoid gasteropod shell. *Hercynella* is a Silurian and Devonian genus which possesses a cone-like exoskeleton, not far from the gasteropod prototype (see Borradaile *et auctt.*, 1935, p. 544). It has an erect apex as a rule, but the cone is modified by a radial ridge and/or sinus. Its later ontogeny is portrayed in a series of growth lines which indicate that it began as a minute cone which enlarged as the animal grew. The embryonic shell or nucleus apparently consisted of a micromorph of the adult shell.

If the fundamental form of the exoskeleton of gasteropods is a cone, then it is to be expected that the earliest gasteropods would conform to this pattern. Cambrian genera such as *Helcionella, Hypseloconus, Metoptoma, Palaeacmaea, Parmorphella, Proplina, Scenella,* and *Tryblidium* are all patelliform or coniform shells. A succession of similar forms can be traced through the various

geological periods, although the genetic relationships of these genera have not yet been fully determined. However, the relationship of *Hercynella* to other genera will now be discussed.

Genetic Relationships

Symmetry is a major concept in zoology. The prototype gasteropod exoskeleton was apparently a symmetrical cone, but modifications of the cone lead commonly from a radial to a bilateral symmetry. The genus *Hercynella* comprises a group of species which are strangely asymmetrical, chiefly because of an eccentric apex and a curious fold and/or sinus characteristic of the genus. Apparent evidence of a previous bilateral symmetry is seen in an early form like *H. patelliformis* (from the Bertie Waterlime), whose apex is not far from the centre, whose outline is regular and not far from the circular, and which has no sharp sinus or elevated fold, but simply a slight inward flexure.

Early workers were by no means certain as to what the relationships of *Hercynella* were. Fischer put the genus in the family Fissurellidae, but commented that it was impossible at the time to classify *Hercynella*. Kayser compared *Hercynella* with the Patellidae and Capulidae, while Perner provided support for a comparison of the genus with the Tertiary gasteropod *Valenciennesia*, a pulmonate which has a very definite groove on the left side accommodating a respiratory tube (see Davies, 1935). Subsequent writers seem to have accepted this hypothesis without re-examination, and looked upon the fold in the shell of *Hercynella* as homologous with the pulmonary groove of *Valenciennesia*. But the fold may, in reality, have no such biological significance, because:

(a) In *H. patelliformis* the "fold" is but a very shallow sinus almost on the longitudinal axis of the shell.
(b) In *H. victoriae* it is a simple fold in the shell with a concave flexure on each side, sharper on one side than the other.
(c) In *H. petasoida* there is a fairly sharp fold and a sharp sinus but they are not contiguous.
(d) In *H. beyrichi*, the genotype, there is a sharp curved fold.
(e) *H. bohemica* has a curved fold, but it is not a raised convex feature, but rather the surface of the shell dropping in and continuing at a lower level.
(f) In some specimens of *H. nobilis*, there are two folds almost opposite each other (Perner, pls. 47 and 49).
(g) In the young specimens of some species (e.g., *H. bohemica*), the fold is almost indiscernible.
(h) In *H. petasoida* and *H. killarensis*, spp. nov., the shell is modified by both a fold and a sinus.

There are a large number of variations, and, in some species, the structure may appear on either the left or the right side of the median axis. It is apparent from this brief description of the variations in *Hercynella* that there is no clear homology between the fold in the shell of this genus and the well-defined, consistently-placed respiratory groove of *Valenciennesia*.

Further, there is reason to believe that the genetic relationships of *Hercynella* are with contemporary fully marine gasteropods rather

than with the Tertiary genus *Valenciennesia*. *Hercynella* ranges from Middle Silurian to Middle Devonian, but appears to have reached its acme in the Lower Devonian. Contemporary genera possessing a similar type of exoskeleton are *Calloconus*, *Orthonychia*, and *Procrucibulum*. *Calloconus* Perner (genotype from the Lower Devonian of Bohemia), is a gasteropod with coniform shell, eccentric apex tilted slightly anteriorly(?), outline of aperture broadly sub-elliptical, and shell thick with concentric undulations; there is no fold or sinus as in *Hercynella*. However, *Hercynella killarcnsis* sp. nov., has an eccentric apex tilted anteriorly and concentric undulations. *Orthonychia* Hall has a shell in the form of a high cone (horn-shaped), with inclined, but not coiled, apex in the simpler form (e.g., the genotype), but having radial folds and some other modifications in other species. The genotype comes from the Lower Devonian of United States of America. *Procrucibulum* Perner (genotype from Bohemian Lower Devonian), is a gasteropod with a patelliform exoskeleton having a slightly twisted apex, and a low sharp ridge rising in the apex inside the shell and passing clockwise in a very gentle spiral, conformable to the twist of the shell, but dying out before reaching the margin. It is to be noted that this is not the coiling of a cone or tube as in a typical gasteropod; but, rather, a twist in the cone itself, reflecting a twisting of the visceral hump—a most interesting fact in view of gasteropod torsion.

It would appear, then, that in the genera *Calloconus*, *Orthonychia*, *Procrucibulum*, and *Hercynella*, we have four related variants of the primitive gasteropod cone, the nearest to which in known fossils is *Palaeacmaca*, whose genotype comes from the Cambrian and whose species stretch into the Ordovician and may be Silurian.

The *Calloconus* exoskeleton presents a bilateral symmetry, having lost the original radial symmetry by having an aperture with a sub-elliptical in place of a circular outline, and also an apex inclined (?) anteriorly; this is the first stage in the enrolment of the gasteropod cone. *Orthonychia* has this same commencement of coiling, and some species have radial folds in the shell.

Procrucibulum modifies the simple conoid exoskeleton by being slightly asymmetric and having a twist or torsion. *Hercynella* possesses typically an asymmetric apex, and is made still more asymmetrical by a radial ridge and/or sinus, which occurs on one side or other of the longitudinal axis.

The foregoing facts suggest that *Palaeacmaea*, *Calloconus*, *Orthonychia*, *Procrucibulum*, and *Hercynella* are, in some way, genetically related. But the last-named genus has hitherto been classified as a pulmonate. I am of the opinion that *Hercynella* is a fully marine gasteropod and not a pulmonate. This hypothesis is based upon its apparent genetic relationships as discussed above; its ecology; and the palaeontological history of pulmonates.

Palaeoecology of *Hercynella*

The genotype of *Hercynella* is derived from the Hercynian fauna of the Harz, which is partly Rhenish and partly Bohemian in its facies. As far as the author is aware, *Hercynella* has not been found in beds of purely Rhenish facies. The largest *Hercynella* fauna in both species

and numbers, comes from Bohemia, from whence also, it is interesting to note, come the genotypes of *Calloconus* and *Procrucibulum*. The facies of these beds is indisputably marine off-shore. The only way in which a pulmonate gasteropod could occur in these beds would be for it to have been transported there from the shore (if an air-breather), or from shallow waters (if a secondary pulmonate), by ocean currents. If this were the case, the shell would show signs of the wear and tear of transport. Moreover, one would not expect to find many individuals present, as it would only be an occasional shell which would be so transported. As far as can be discovered from the literature, there are no signs of current bedding in these strata, the shells do not show the wear and tear of transport, and the individuals are numerous, there being present fifteen species, some in comparatively large numbers.

This evidence of the facies of *Hercynella* is well supported by the results of a study of the facies of the Lower Devonian fauna of Killara, Victoria, from which the species described in this paper were derived. At Killara, three facies can be distinguished:

(a) A near-shore facies, the rocks consisting of quartzites and sandstones.

(b) An off-shore facies, the rocks consisting of mudstones and very fine sandstones (they look like mudstones, but grit on the teeth).

(c) A pelagic facies, the rocks consisting of thinly-bedded mudstones (some white), with a pelagic fauna including very numerous minute *Styliolina fissurella*.

It is in the second, the off-shore facies, that the species of *Hercynella* described in this paper have been found. The fauna (so far as it has been worked out), consists of the following:

TRILOBITA

Acanthopyge australis (McCoy)
Calymene bawiei Gill
C. killarensis Gill
Gravicalymene sp.
Odontochile sp.
Odontopleura sp.
Phacops aff. *fecundus* Barrande
Phacops sp.

BRACHIOPODA

Acrospirifer (?) *lilydalensis* (Chapman)
Anoplia australis Gill
A. withersi Gill
Chonetes bowieae Gill
C. robusta Chapman
C. psiloplia Gill
C. killarensis Gill
Dalmanella aff. *elegantula* (Dalman)
Fascicostella gervillei Defrance
Hipparionyx minor Clarke
Leptaena rhomboidalis (Wilckens)
Nucleospira australis McCoy
Plectodonta bipartita (Chapman)

PELECYPODA

Conocardium bellulum (Cresswell)
Ctenodonta portlocki Chapman
Cypricardinia contexta Barrande
Mytilarca acutirostris Chapman

Nucula lamellata Hall
Nuculites maccoyianus Chapman
Nuculoidea opima australis (Chapman)
Tancrediopsis raricostae (Chapman)

GASTEROPODA

"*Bellerophon fasciatus* Lindstrom"
Euomphalus centrifugalis Chapman
Hercynella killarensis, sp. nov.
H. petasoida, sp. nov.
H. victoriae Chapman
"*Pleurotomaria*" *maccoyi* Chapman
Scalaetrochus antiquus (Cresswell)

OSTRACODA

Beyrichia cf. *kloedeni* McCoy
B. ligatura Chapman
B. maccoyianus australiae Chapman
B. wooriyallockensis Chapman

ANTHOZOA

"*Lindstroemia*" *ampla* Chapman
"*L.*" *yeringae* Chapman
Pleurodictyum megastomum Dun

OTHER ANIMALIA

Conularia chapmani Fletcher
Fenestrellina margaritifera (Chapman)
Undet. orthoceracones

PLANTAE

Hedeia corymbosa Cookson

Of the above list (covering fossil localities 33, 34, and 35—see Gill, 1945, pp. 179, 183-184), the trilobites and brachiopods have been critically studied, but not the other groups. However, the names given are quite sufficient to indicate the type of fauna. There are a number of strophеodontids and spiriferids (not the heavy, costate, near-shore types), yet to be named. The gasteropods are not common and *Hercynella* itself is rare. The other groups, as such, are plentiful. The plants were probably swept out to sea by some river, as *Hedeia* is definitely a land plant. They occur mostly as broken, unidentifiable fragments. In spite of a great deal of collecting, only one determinable fragment has been found. Plants have been collected also in the Bohemian fauna at Lilydale.

Chapman (1917, p. 126) claimed that because the *Hercynella* shells are thin, they suffered from calcium starvation brought about probably by dilution of the sea water with fresh water, and by the deleterious effect of mud from terrigenous sources. Although the *Hercynella* shells at Killara are thin, those of the brachiopods and pelecypods are not; no difference being noted between those at Killara and those elsewhere. Thick-walled *Pleurodictyum* and *Lindstroemia* indicate that there was no lack of calcium salts in the sea water. Moreover, although plants may have drifted out to sea to be associated with the fauna, it cannot be regarded as an area in which the currents of a river were felt. This is shown by the fineness of the sediments, indicating quiet if not deep water; the lack of current bedding, and the presence of a normal off-shore type of fauna. The thinness of the *Hercynella* shells is therefore to be regarded as due to genetic constitution and not to ecological conditions.

The fact that Killara possesses a Bohemian type of fauna makes it very probable that the well-preserved species of *Hercynella* found there are normal marine gasteropods and not pulmonates. Being so

thin-shelled, they could probably not stand up to the conditions of the more turbulent near-shore facies affected by tides and currents, and they could certainly not stand up to much transport when empty.

Palaeontological History of Pulmonates

It would appear that certain Tertiary forms which closely resemble extant pulmonates belong without doubt to that class. Unfortunately, zoological definitions cannot be applied to fossil pulmonates, and so analogy has to be one's guide.

But there is no genus which can be readily referred to the Pulmonata earlier than the Mesozoic. *Anisomyon* (a form which the author has not been able to study) is classified as a pulmonate, and dates from the Jurassic. The indubitable pulmonate shells date from Tertiary to Recent. As far as the writer is aware, no gasteropods have been referred to the Pulmonata between *Hercynella* in the Middle Devonian and *Anisomyon* in the Jurassic. This lacuna calls for explanation; the imperfection of the palaeontological record does not appear to be a sufficient answer.

In addition, there is good evidence for believing that aqueous pulmonates have secondarily returned to that environment. Pulmonates in a water habitat have the "lung" filled with water, and apparently oxidation is effected through the membrane lining that organ and through the other surfaces in contact with the water. Such pulmonates may be termed secondary pulmonates. Most of these are freshwater forms, but some are marine, and are found in water up to 10 fathoms deep.

Now if *Hercynella* is a pulmonate, it must be regarded as a secondary pulmonate, because it is found in an undoubted marine environment. But that the ancestors of *Hercynella* left the sea, evolved the pulmonate structure, then returned to the sea by the Middle Silurian is altogether unlikely. Pulmonates on land would depend on land plants for food. No land plants older than Upper Silurian are known, and in most areas they have not been discovered earlier than Lower Devonian.

There is thus strong cumulative evidence from the apparent genetic relationships of *Hercynella*, its palaeoecology, and the general palaeontological history of pulmonates, to support the hypothesis that *Hercynella* is a normal marine gasteropod and not a pulmonate.

Description of Species

A single species of *Hercynella* has been described from Victoria by Chapman (1916), who also commented on the ecology of the genus (1917). Other passing references to the genus have been made (Chapman 1906, 1908, Chapman and Thomas, 1935). Further collecting has brought to light other specimens of this species, and examples of two new species, which are now described.

Hercynella victoriae Chapman

[Plate VII, fig. 4]

Chapman 1916, pp. 99-100, Pl. V, figs. 47, 48

Holotype. This is the steinkern of an almost complete shell in grey mudstone from Syme's Tunnel, Killara (loc. 34), and is Reg. No. 12858 of the National Museum, Melbourne.

Stratigraphic Position. Yeringian (Lower Devonian).

New Description of Holotype. Apex erect. Aperture roughly oval. Longitudinal profile as seen in fig. 1a. The keel characteristic of the genus is on the holotype straight, prominent, and with an inward flexure of the shell on each side. The measurements are:

Diameter through keel	5.1 cms. (incomplete)
Diameter at right angles to above . .	3.1 cms. (incomplete)
Height	1.1 cms. approximately

The ornament consists of very fine folds (they must affect the whole thickness of the shell because they occur on both the steinkern and the external mould), about 15 per centimetre. It is faint near the apex but becomes well defined at the margin. Somewhat discontinuous concentric growth lines present.

Comment. As Chapman has said, this form is most like *H. radians* of the Bohemian Lower Devonian. It is similar in ornament, and in being a flat type, but differs in the position and nature of the apex, and in the shape of the aperture.

Chapman's paratype (Reg. No. 12857 in the National Museum, Melbourne) is a crushed specimen which shows the nature of the ornament more clearly (14 ribs per cm. were counted).

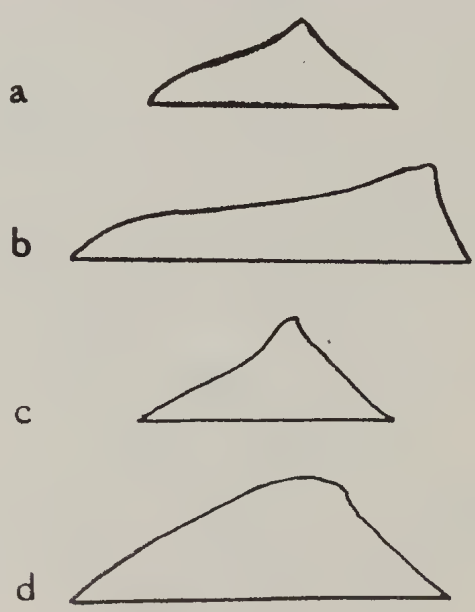

Figure 1.

Median longitudinal profiles of species of *Hercynella* (actual size) orientated so that the end accepted as anterior is on the right of the diagram in each case.

a. H. victoriae, holotype.
b. H. victoriae, hypotype.
c. H. petaxoida, holotype.
d. H. killarensis, holotype.

Hypotype (Pl. VII, fig. 4). A well preserved specimen of this species has been collected from Syme's Quarry, Killara (loc. 35), and is now described as a hypotype. It is a steinkern in brown mud-

stone, and is Reg. No. 1935 of the collection of the Department of Geology, University of Melbourne. The specimen was collected by Mrs. R. Bowie, of Killara.

STRATIGRAPHICAL POSITION. Yeringian (Lower Devonian).

DESCRIPTION OF HYPOTYPE. Patelliform exoskeleton, with eccentric apex (damaged, but probably erect). Aperture quasi-circular. Keel characteristic of the genus formed by fold extending from apex to margin, and with broad inward flexure on each side. The perimeter of the shell on the fold side is incomplete, but the measurements of the specimen as it stands are:

Diameter through fold	6.0 cm.
Diameter at right angles to above	5.2 cm.
Distance of apex from one end of second diameter	about 1.0 cm.
Height of apex above plane of perimeter	about 1.5 cm.

The ornament (as seen on the steinkern) consists of fine radial folds which are hardly discernible in the region of the apex, and which gradually widen towards the perimeter of the shell. Some bifurcate towards the margin. There are about nine folds per centimetre at the margin on the side opposite the fold or keel. The folds are finer where the perimeter comes nearer the apex. The depressions between the folds are about half the width of the latter. There are a few incomplete fine concentric ridges which apparently represent slight variations in growth rate. The longitudinal profile of the shell is shown in fig. 1b. The small distance between steinkern and mould (seen when clearing the fossil) indicates that the shell was thin, nearer the edges at any rate. No muscle scars discernible.

COMMENT. This specimen shows the nature of the margin of the shell on the side on which it is incomplete in the holotype, viz., it is broadly rounded. The ornament consists of folds which affect the whole thickness of the shell; this corrugation would give added strength to the thin exoskeleton.

It will be noticed that the hypotype has a larger ornament at the margin, and that the apex is in a relatively different position from that in the holotype. Both these things are probably mainly due to the larger size of the shell. If the ornament on the hypotype is measured at the same distance from the apex as is the margin on the holotype, it is found to be about the same. Further, as the anterior side of the shell is steep and the posterior shelving, it is clear that with growth the relative position of the apex will be nearer the anterior margin (see p. 81) for orientation accepted for these shells). This does not explain all the difference, but when a larger series of specimens is available, it will be quite easy to settle these points.

HERCYNELLA PETASOIDA, *sp. nov.*

[Pl. VII, figs. 1, 2]

TYPE MATERIAL. Syntypes consisting of the external mould (University of Melbourne, Dept. of Geology, Reg. No. 1934) and internal cast or steinkern (Reg. No. 1933) of a specimen complete but for part of the margin; preserved in bluish grey indurated mudstone from Syme's Tunnel, Killara (see Gill, 1945, p. 179, for locality).

STRATIGRAPHICAL POSITION. Yeringian (Lower Devonian).

Description. Depressed conoid; anterior-posterior profile as fig. 1c. Apex rather accentuated through slight crushing (to be expected owing to thinness of shell), erect, nearer one margin than other, i.e., eccentric. Aperture sub-oval. Conicoid shape interrupted by both a keel (elevated) and a sinus (depressed). The angle between these is approximately 70°. Both keel and sinus extend from the apex to the perimeter.

The "ornament" consists of a number of fairly complete concentric ridges; these appear to be accentuated growth lines. There are also some very faint radial lines, which are very much finer (about 5 per mm.) than the prominent radial ornament of *H. victoriae*.

Measurements. The radius on the side opposite to the keel is 2.5 cm. The shell is about 1 cm. high.

Comment. When collecting the fossil, I thought the sinus was an artefact due to crushing, but apparently it is a genuine feature. Like *H. victoriae*, this form has an erect apex, and in this differs from *H. killarensis*, sp. nov. The trivial name is derived from the Greek and Latin word *petasus*, a broad-brimmed hat.

Hercynella killarensis, sp. nov.
[Pl. VII, fig. 3]

Type Material. Holotype, consisting of a steinkern in grey indurated mudstone, from Syme's Tunnel, Killara (Gill's loc. 34). Specimen complete except for slightly broken margin. Collected by Mr. F. Chapman and housed in National Museum, Melbourne (Reg. No. 14524).

Stratigraphical Position. Yeringian (Lower Devonian).

Description. Patelloid; anterior-posterior profile as in fig. 1d. Aperture sub-oval. Apex eccentric, blunt, and inclined anteriorly. Radial keel or fold extends from the apex to the margin, and is straight; it is rounded and there is an inward flexure of the shell on each side, that on the anterior side being more pronounced. There is a clearly defined but shallow sinus on the anterior side of the keel; the angle between the two is about 70°. A conspicuous outward flare of the margin where the keel meets it is present as in *H. bohemica*.

The ornament consists of a series of concentric undulations. There are traces of a very fine radial ornament.

Measurements.

Diameter through keel	5.5 cms.
Diameter at right angles to this	4.5 cms.
Height	about 1.6 cms.

Comment. This species is very interesting in that the apex is not erect, but incipient enrolment is present as in the allied genus *Calloconus*. The occurrence of a sinus as well as a keel, as in *H. petasoida*, sp. nov., indicates a relationship with this species from the same locality. *H. killarensis* differs from *H. petasoida* chiefly in having a non-erect apex and a different type of keel. In shape the new species resembles *H. nobilis* Barrande, which has two keels instead of a keel and a sinus as in this species under discussion; there is also a similarity of ornament. The apex in *H. nobilis* is very blunt as in *H. killarensis*, but is apparently erect.

In the palaeontological collection of the Geology Dept. of the University of Melbourne (Reg. No. 755), there is an external mould of *H. killarensis* which shows the concentric undulations clearly, and superimposed on these there are concentric lirae. There are traces of these on the holotype steinkern, and are probably better developed on this specimen because it shows the outside surface of the shell.

It is to be noted that in *H. nobilis* there are slight variations in the degree of development of concentric undulations and lirae, and of radial lirae.

HERCYNELLA sp.

In the National Museum, Melbourne, there is a crushed specimen of *Hercynella* from Ruddock's Quarry, near Lilydale (Gill's loc. 20). There is a more or less complete steinkern (Reg. No. 14525) and a piece of the external mould (Reg. No. 14526). It measures about 5½ cm. through the fold, and about 3.7 cms. along a diameter at right angles to that. The fossil has the conspicuous radial ornament of *H. victoriae*, but at the distance from the apex where that species has 15 ribs per cm., this specimen has 21. Its chief interest is that it occurs in a different district, and constitutes another facies and stratigraphical link between the Lilydale synclinorium and the Killara synclinorium.

Stratigraphy

The species of *Hercynella* described in this paper have come from the two main outcrops of Lower Devonian beds of Bohemian facies in Victoria—Lilydale and Killara. None has been found in the areas of outcrop of Lower Devonian beds of Rhenish facies, such as at Kinglake. Once again, too, the forms most like those from Lilydale and Killara are to be found in the Lower Devonian beds of Bohemia.

References

BORRADAILE, L. A., POTTS, F. A., EASTHAM, L. E. S., and SAUNDERS, J. T., 1935. The Invertebrata. Cambridge.

CHAPMAN, F., 1906. A New Cephalaspid from the Silurian of Wombat Creek. *Proc. Roy. Soc. Vic.*, n.s., Vol. 18, pt. 2, pp. 93-100.

———, 1908. Reports on Fossils. *Rec. Geol. Surv. Vic.*, Vol. 2, Pt. 4, pp. 207-208.

———, 1916. New or Little-known Fossils in the National Museum, Pt. 19. The Yeringian Gasteropod Fauna. *Proc. Roy. Soc. Vic.*, n.s., Vol. 29, Pt. 1, pp. 75-103.

———, 1917. On the Probable Environment of the Palaeozoic Genus *Hercynella* in Victoria. *Proc. Roy. Soc. Vic.*, n.s., Vol. 29, Pt. 2, pp. 123-126.

———. and THOMAS, D. E., 1935. Outline of the Physiography and Geology of Victoria: Silurian. *Aust. and N.Z. Assoc. Adv. Sc., Handbook.*

COSSMANN, M., 1878. Essais de paléoconchologie comparée, Vol. 1. Paris (Not seen).

DAVIES, A. M., 1935. Tertiary Faunas, Vol. 1. London.

GILL, E. D., 1940. The Silurian Rocks of Melbourne and Lilydale: A Discussion of the Melbournian-Yeringian Boundary and Associated Problems. *Proc. Roy. Soc. Vic.*, n.s., Vol. 52, pt. 2, pp. 249-261.

———, 1942. The Thickness and Age of the Type Yeringian Strata, Lilydale, Victoria. *Proc. Roy. Soc. Vic.*, n.s., Vol. 54, pt. 1, pp. 21-52.

———, 1945. Trilobita of the Family Calymenidae from the Palaeozoic Rocks of Victoria. *Proc. Roy. Soc. Vic.*, n.s., Vol. 56, pt. 2, pp. 171-186.

KAYSER, E., 1878. Die Fauna der Ältesten Devon-Ablagerungen des Harzes. *Abhand. geol. Specialkarte Preuss. und Thür. Staaten*, Bd. 2, Heft. 4.

KNIGHT, J. B., 1941. Paleozoic Gastropod Genotypes. *Geol. Soc. Amer.*, Special Papers, No. 32.

O'CONNELL, MARJORIE, 1914. Description of Some New Siluric Gastropods. *Bull. Buffalo Soc. Nat. Sci.*, Vol. 11, No. 1, pp. 93-101.

PERNER, J., 1911. Système Silurien du Centre de la Bohême, Pt. 1, Vol. 4, Tome 3, Prague.

Description of Plate

PLATE VII

All figures approximately same size.

Fig. 1.—*Hercynella petasoida*, sp. nov., external mould. Syntype.
Fig. 2.—*H. petasoida*, sp. nov., steinkern (internal cast, as defined by Knight, 1941). Syntype.
Fig. 3.—*Hercynella killarensis*, sp. nov., steinkern. Holotype.
Fig. 4.—*Hercynella victoriae* Chapman, steinkern. Hypotype.

The photographs were taken by Mr. L. A. Baillôt, of the Melbourne Technical College, to whom the author's thanks are due.